

WHAT IS CLAIMED IS:

1. A method for fabricating semiconductor devices comprising at least: a first step for forming a first insulating material layer on a sample; a second step for forming on said first insulating material layer a second insulating material layer with a dielectric constant less than 2.5; a third step for patterning said second insulating material layer by a plasma etching method; a fourth step for depositing a metal film on said second insulating material layer by a sputtering method; a fifth step for forming a copper layer on said metal film; and a sixth step for removing an unnecessary portion of said copper layer by Chemical Mechanical Polishing, wherein all the processes from said third to said fourth step are performed under drying process conditions, and a pure water treatment for cleaning said sample with pure water is provided after said sixth step.

2. The method for fabricating semiconductor devices according to claim 1, wherein said sample is not exposed to the atmosphere during all the periods from the start of said third step to the end of said fourth step.

3. The method for fabricating semiconductor devices according to claim 1 or 2, further comprising, after said third step and before said fourth step, an etching process for removing predetermined part of said first insulating material layer by etching by means of

plasma of a mixed gas containing NF_3 and Ar through an opening patterned in said second insulating material layer in said third step.

4. The method for fabricating semiconductor devices according to claim 3, wherein said etching process is performed by setting the bias electric power per unit sample area applied to the sample to below $0.16\text{W}/\text{cm}^2$.

5. The method for fabricating semiconductor devices according to claim 3 or 4, wherein said etching process is performed by setting the processing plasma pressure to below 0.5Pa .

6. The method for fabricating semiconductor devices according to any one of claims 3 to 5, further comprising, immediately after said etching process, a process for subjecting to said sample an O_2 or H_2 plasma processing.

7. A plasma etching processing apparatus comprising: a sample table for placing a sample provided in a reduced pressure processing chamber; gas introduction means for introducing a processing gas into said reduced pressure processing chamber; exhaust means for exhausting said processing gas out of said reduced pressure processing chamber; and means for generating plasma of said introduced processing gas in said reduced pressure processing chamber, further comprising: magnetic field apply means for applying a magnetic field to said sample provided on the back

surface of said sample; and voltage apply means for ON-OFF applying to said sample a negative DC voltage in which the OFF period of the ON-OFF application is below 10^{-6} seconds.

5 8. A dry etching method comprising using the plasma etching processing apparatus according to claim 7 to etch an insulating film deposited on a copper layer provided on a sample under the conditions of said negative DC voltage of below 200V.

10 9. An apparatus for fabricating semiconductor devices comprising a sputtering processing chamber for depositing a metal film on a semiconductor sample by a sputtering method; and an etching processing chamber for etching an insulating film on the semiconductor sample by a dry etching method, further comprising: a
15 plasma processing chamber for performing a plasma processing of the semiconductor sample; and exhaust gas processing equipment capable of subjecting both combustible gas and combustion buck up gas to an
20 exhaust gas process.

10. The apparatus for fabricating semiconductor devices according to claim 9, further comprising gas introduction means for introducing at least three gases of NF_3 , H_2 , and O_2 into said etching processing chamber.